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Growth Kinetics and Structural Evolution of Apatite Coatings on Titanium Alloy in Simulated Body Fluid.

Abstract:
Apatite coatings formed on metallic substrates such as Ti-6Al-4V (Ti64) can promote osseointegration and are of significant interest for orthopaedic and dental implant applications. However, the slow formation of apatite layers in conventional simulated body fluid (SBF). In this study, we investigate the growth kinetics of apatite layers formed on Ti64 substrates using an enhanced biomimetic approach. A modified version of Kokubo's SBF, referred to as 3×SBF, is employed to accelerate the nucleation and growth of the apatite coating. Ti64 samples are immersed in 3×SBF for varying durations 7, 14, and 21 days to systematically assess the evolution of the coating layer.
A multi-technique characterisation approach implemented to determine the growth kinetics and coating properties. Energy Dispersive X-ray Spectroscopy (EDS) was used to determine the elemental composition and monitor the Ca:P ratio over time, allowing comparison to the stoichiometry of natural bone mineral. X-ray Diffraction (XRD) was employed for phase identification and to track changes in crystallinity and crystal structure associated with apatite maturation. A fluorescent confocal microscope was utilized to investigate the spatial dynamics of mineral deposition, quantify porosity, assess coating thickness, and conduct depth profiling. Together, these techniques provide a comprehensive understanding of the temporal and structural evolution of the apatite layer on Ti64, providing insight into the mechanisms involved in biomimetic coating growth. The results aim to inform strategies for a faster and more effective biomimetics coating for bioactive implant surfaces.
Key words: Apatite, Titanium alloy (Ti64), Biomimetic coatings, In vitro, Calcium phosphate (CaP), Biocompatibility.

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